The status of the mixture is described in the table.

Professor Harry F. Reid informs me that a continental shelf of the Atlantic Ocean has a very definite slope which is very nearly that obtained for the extremely wet sand in these experiments.

I reserve the mathematical theory for a future paper.

| SAND | WATER | ANGLE OF REPOSE | REMARKS |
|---|---|---|---|
| *pounds* | *pounds* | | |
| 10 | 0 | 33° | Dry |
| 10 | 0.5 | 65° | Not hard |
| 10 | 1.0 | 120° | Not accurate, but large obtuse angle, hard |
| 10 | 1.5 | 120°–140° | Not accurate, but large obtuse angle, hard |
| 10 | 2.0 | 120°–140° | Not accurate, but large obtuse angle, hard |
| 10 | 2.5 | 120° | Not accurate, but large obtuse angle, hard |
| 10 | 3.0 | 48° | Fairly hard |
| 10 | 3.5 | 19° | All mixes |
| 10 | 3.75 | 14.5° | Very slight excess of water |
| 10 | 4.0 | 13° | Water not all absorbed |
| 10 | 5.0 | 12° | Excess of water |

The sand has been meshed by Professor Roys of the Worcester Polytechnic Institute with the following results:

| SIZE OF SCREEN | DIAMETER OF OPENING | PER CENT OF SAND WHICH PASSED THROUGH |
|---|---|---|
| *meshes* | *inches* | |
| 200 | 0.0029 | 7.3 |
| 100 | 0.0055 | 29.55 |
| 50 | 0.011 | 84.60 |
| 30 | 0.022 | 99.45 |
| 20 | 0.034 | 99.85 |
| 10 | 0.073 | 99.95 |
| 4 | 0.20 | 100.00 |

## *PALÆOMASTODON, THE ANCESTOR OF THE LONG-JAWED MASTODONS ONLY*

By Henry Fairfield Osborn

American Museum of Natural History, New York City

Read before the Academy, April 29, 1919

In 1900[1] the author predicted that the ancestors of the Proboscideans, as well as of the Hyracoidea and some other orders of mammals, would be discovered in Africa. Two years later the members of the British Geological Survey of Egypt discovered in the Oligocene of the Fayûm remains of *Palæo-*

*mastodon* and of *Mœritherium*, which were at once regarded as the solution of the ancestry of the Proboscideans. These animals took their place in all literature as two steps in the early evolution of this remarkable group.

In 1909[2] Osborn pointed out that *Mœritherium* is to be regarded as a terrestrial form of the Sirenians (manatees and dugongs) in no way directly related to the Proboscideans. It now appears that *Palæomastodon* must also be removed from its generalized position and be regarded as the ancestor of the long-jawed mastodons only; it is far too much specialized in the longirostral direction to be ancestral to the Proboscidea in general. These long-jawed mastodons are distinguished by the peculiar use of the front teeth of the lower jaw, which together made a broadly flattened, spoon-shaped tooth,

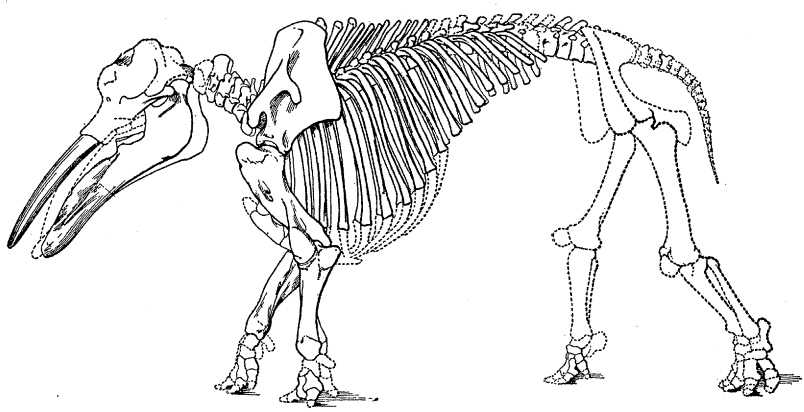

FIG. 1

Outline of the mounted skeleton of *Megabelodon* in The American Museum of Natural History, discovered by E. L. Troxell in the Middle Pliocene of Texas. Drawing one forty-fifth natural size.

almost entirely enamel covered. Phases of the evolution of this long-jawed phylum are seen in the classic *Trilophodon angustidens* of Cuvier, in the lower Miocene of France. A branch reached Texas in the Upper Miocene (*Trilophodon productus* of Cope), and Florida as well as Texas in the *Trilophodon serridens* of Cope. It attained gigantic proportions in the Middle Pliocene. The *Megabelodon* of Barbour, a superb skeleton of a long-jawed and extremely short-limbed Proboscidean, recently discovered in Texas by Mr. E. L. Troxell, has been mounted in The American Museum of Natural History. It represents one of the culminating stages in the evolution of the long-jawed mastodons. In these animals we find proof of nearly direct linear descent from the *Palæomastodon* of the Fayûm, e.g., the long enamel band on the upper tusks, the broadly spoon-shaped arrangement of the lower tusks with enamel covering. In massiveness these animals parallel and even surpass the true mastodons of the Pleistocene, to which they are only indirectly related.

[1] Osborn, 1900, 182. [2] Osborn, 1909, 332.